

nervous tissue, the development of the mind as well as the machinery of the mind becomes perfectly possible. We develop our intellect through the accumulation of exact facts, through the collation of pure facts, no matter whether it be a humble kind of a truth—as the knowledge of the changes of the seasons, which induces some animals to lay up the winter's store—whether it be knowledge of the fact that the sting of the bee is very unpleasant, or knowledge of the fact (of which the ox, no doubt, is thoroughly aware) that the teeth of the wolf are not pleasant to come in contact with, or whether it be the complex knowledge of man. When the cerebral matter has become larger and more complex, it receives and retains a much greater number of impressions, and the animal becomes a more highly educated being.

As regards the department of emotions or passions, it is also much stimulated by the environment. Animals which live in a state of constant strife naturally have their antagonistic passions much developed, while amiable, sympathetic sentiments are better and more largely produced by peace-loving animals. Thus it is that the various departments of the mind have the beautiful results which we now find in the human species.

There are some departments of the mind which some of our friends decline to admit having had such an origin. The moral faculty, for instance, is excepted by many from this series. But the reasons why they object to its production in this way are, to my mind, not valid. The development of the moral faculty, which is essentially the sense of justice, appears to them not to fall within the scope of a theory of descent or of evolution. It consists of two parts. First is the sentiment of benevolence, or of sympathy with mankind, which gives us the desire to treat them as they should be treated. It is not sufficient for justice that it is unmix'd mercy, or benevolence, which is sometimes very injurious, and very often misplaced. It requires, in the second place, the criticism of the judgment, of the mature intellect, of the rational faculty, to enable the possessor to dispose of his sentiments in the proper manner. The combination of rational discrimination and true judgment with benevolence constitutes the sense of justice, which has been derived, no doubt, as a summary of the development of those two departments of the mind, the emotions and the intellect.

It is said that a sense of justice could not be derived from the sense of no justice; that it could not have been derived from the state of things which we find in the animals, because no animal is known to exhibit real justice: and that objection is valid as far as it goes. I suspect that no animal has been observed to show a true sense of justice. That they show sympathy and kindness there is no question; but when it comes to real justice they do not display it. But do all men display justice? Do all men *understand* justice? I am very sure not. There are a good many men in civilised communities, and there are many tribes, who do not know what justice is. It does not exist as a part of every mental constitution. I never lived among the Bushmen, and do not know exactly what their mental constitution is; but in a general way the justice of savages is restricted to the very smallest possible circle—that of their tribe or of their own family. There is a class of people who do not understand justice. I do not refer to people who know what right is, and do not do it; but to the primitive state of moral character, in which, as in children, a sense of justice is unknown. I call attention to the fact because some of our friends have been very much afraid that the demonstration of the law of evolution, physical and metaphysical, would result in danger to society. I suspect not. The mode in which I understand this question appears to me to be beneficial to society, rather than injurious; and I therefore take the liberty of appending this part of the subject to its more material aspect.

To refer to another topic, and that is to the origin of life, the physical basis of life. The word "life" is so complex that it is necessary to define it, and so to define it away that really the word "life" does not retain its usual definition. Many phenomena of life are chemical, physical, mechanical. We have to remove all these from consideration, because they come within the ordinary laws of mechanical forces; but we have a few things left which are of a different character. One is the law of growth, which is displayed in the processes of embryonic succession; secondly, the wonderful phenomena of sensibility. Those two things we have not yet reduced to any identity with the ordinary laws of force. In the phenomena of embryology the phenomena of evolution are repeated, only concentrated in the early stages through which animals have to pass. So whatever

explains the general phenomena of evolution explains the phenomena of embryology.

What is the nature of physical sensibility? In this planet it is found residing only in one form of matter which has a slightly varied chemical constitution, namely, protoplasm; so called from a physical standpoint. Now this world, as you all know, has passed through many changes of temperature. Its early periods, it is probable, were so very hot that protoplasm had a very poor chance. The earth has passed through a great many changes of temperature, many of which would not permit the existence of protoplasm. Again, can we assume for a moment that this little speck in the great universe is the only seat of life? I suppose scarcely any scientific man will venture to do so. If, therefore, life exists in other parts of this great universe, does it necessarily occupy bodies of protoplasm in those different, remote spheres? It would be a great assumption. It is altogether improbable. The certainty is that in those planets which are in proximity to the sun's heat there could be no protoplasm. Protoplasm in the remote planets would be a hard mineral, and near the sun it would be dissipated into its component gases. So that, if life be found in other parts of this universe, it must reside in some different kind of material. It is extremely probable that the physical conditions that reside in protoplasm might be found in other kinds of matter. It is in its chemical inertness and in its physical constitution that its adaptation to life resides; and the physical constitution necessary for the sustentation of life may be well supposed to exist in matter in other parts of the universe. I only say the door is open and not closed: any one who asserts that life cannot exist in any other material basis than protoplasm is assuming more than the world of science will permit him to assume. And that it is confined to this single planet, and not in the great systems of the universe,—that assumption will not for a moment be allowed. Therefore the subject is one which allows us a free field for future investigation: it is by no means closed in the most important laws which it presents to the rational thinker. I hope, therefore, if the evidence in favour of this hypothesis of the creation of living forms be regarded as true, that no one will find in it any ground for any very serious modification of existing ideas on the great questions of right and wrong, which have long since been known by men as a result of ordinary experience, and without any scientific demonstration whatsoever.

THE REMARKABLE SUNSETS

WE have received the following further communications on this subject:—

REFERRING to Mr. Meldola's letter in your last number (p. 224), I beg leave to state that I likewise observed an astonishing atmospheric luminosity, out of this town, at 2-3 a.m. in the moonless and foggy night of January 1-2. It is reported that in these days the "Dämmerungserscheinungen" have again been very striking at many places in Germany. Here the state of the atmosphere has of late been unfavourable for observing these phenomena; their most brilliant display, a "red glow" of extraordinary extent and intensity, I witnessed on the morning of December 1, beginning about two hours before sunrise.

The view that these luminosities are caused by volcanic dust acting as nuclei for the condensation of vapour in the higher strata of the atmosphere will have suggested to many of your readers the probability of so-called cosmical dust being often derivable from similar terrestrial sources. To me it has, moreover, recalled an hypothesis on the origin of meteorites, put forth some twenty years ago in an elaborate treatise by Mr. P. A. Kesselmeyer of Frankfurt-on-the-Maine ("Abhandlungen der Senckenbergischen Naturforschenden Gesellschaft," vol. iii.). Mr. Kesselmeyer contends for the derivation of meteorites from condensation of metallic and other vapours issued from volcanoes; he distinctly supposes those of Eastern Asia as chief sources, and, among other ingenious reasons for these views, he particularly insists on remarkable statistics of geographical and seasonal distribution of stone-falls (NATURE, vol. xvi, p. 558).

I am well aware of the momentous difficulties of this hypothesis, which fails to explain why such masses of vapour (or dust), after travelling for enormous distances, become condensed into solid bodies. On the other hand, there appears to me not to be such a contradiction to astronomical theories as might seem at first sight; the view in question would merely involve the assumption that there are fireballs and fireballs: those which

precede the fall of meteorites being of a distinct nature from those which accompany the periodical swarms of shooting stars, and thereby manifest their cosmical origin. As far as I know there does not exist a connection, which might be expected by the usual theory, between these periodical swarms and increased frequency of stone-falls; on the other hand, it is evident that the late extraordinary manifestations of volcanic activity must furnish a crucial test for the hypothesis in question; if it were right, there must be expected an augmented fall of meteorites to follow this period of dust-spreading. D. WETTERHAN

Freiburg, Badenia, January 5

AMONGST the many interesting points for consideration in connection with the late sunset phenomena is the very general prolongation of twilight produced by them, doubtless from the reflection of the sun's rays from clouds or diffused vapour at a more than ordinary elevation, after the sun had set to all at a lower level. In reference to this subject, Mr. E. Douglas Archibald states that he estimated the height of a *glowing stratum* (i.e. diffused clouds) as from ten to thirteen miles; that Miss Ley, from calculation, had given thirteen miles as the height of a similar cloud, and in continuation he says:—"I think this height is far more probable than forty miles, as calculated by Prof. Helmholtz. Besides, can we imagine either vapour, or volcanic dust, or a mixture of both, to be capable of remaining in suspension in the air of such tenuity as must exist at such an altitude?" (NATURE, December 20, 1883, p. 176). To this question I would reply by another, and ask if we can imagine vapour or volcanic dust to be capable of remaining in suspension in air of some 17,000 times less density than water, at, at thirteen miles, high, that is about the calculated comparative density of the two.

Or I will go farther, and ask if any one can imagine that water, which is about 860 times heavier than the air at sea-level, can be suspended in the atmosphere without the aid of some buoyant power.

A theory on the cause of rain, storms, the aurora, &c., which I submitted to the British Association at the Glasgow Meeting, 1840 (see Report), was briefly as follows:—

That, as electricity coats the surface of all bodies, occupies space, and has no weight, in evaporating, the minute particles of water take up electricity in accordance with their surface and temperature, and are buoyed up into the atmosphere by it, where, if condensed (i.e. cooled), their capacity for electricity is reduced, and the surcharge is retained or passes away in accordance with the conducting or non-conducting state of the atmosphere. I cannot go further into particulars in this paper, but I may say that I have no knowledge of any phenomenon connected with the cause of rain which is not explicable in accordance with the theory, although forty years' exertion has not enabled me to bring it fairly under consideration.

In my first paper I suggested, as a test for the theory, that conductors should be raised from the earth to the regions of the clouds, under the idea that the withdrawal of electricity by this means would produce rain in temperate, and the aurora in frigid regions. And I hold that I am fully borne out on both these points by Prof. Lemström's grand auroral experiment; as, on the connection being made between the wirework on the top of the mountain and the earth at the foot of it, electric currents were observed, the aurora became visible, and the formation of ice on the wirework was so heavy as to break it down; thus showing that rain would have fallen if the experiment had been tried in a lower latitude. I hold also that the experiment already proves that electricity is the buoyant power of vapour in the atmosphere.

With respect to the undoubted great elevation of vapour and volcanic dust thrown up by the Java eruption, I have long been led to believe that electricity coats the surface of bodies in accordance with their temperatures, and that the non-burning property of superheated metal is from the intense force with which electricity coats the surface, and thus the hand is not actually in contact with the metal when placed upon it; and in the case of effluent high-pressure steam, I believe the particles are so completely wrapped up in their coatings of electricity that they do not touch the object the steam impinges on. Bearing these points in mind, it may easily be imagined that particles of dust or water as vapour, when cast up from a volcano, may be at the highest conceivable temperature, and charged with electricity in a like degree, and that, being driven up by currents of heated air, the particles may rise to an elevation far

above that of ordinary vapour, and may remain suspended there, more or less, in accordance with the non-conducting condition of the atmosphere at such elevations. G. A. ROWELL

Oxford, January 2

AMONGST the many interesting questions raised by the discussion on the recent sunsets, not the least interesting is the question of the upper currents of the atmosphere. Mr. Norman Lockyer, in his article in the *Times* of December 8, writes of the presumed translation of volcanic dust round half the equatorial circumference of the earth in six days as being in accordance with our actual knowledge of these currents. There are probably many readers of NATURE besides myself who would be glad to be referred to the observations upon which this statement is founded.

An opinion prevails that, in the rotation of the earth about its axis, the higher parts of the atmosphere must to a certain extent lag behind, thus producing an east wind relatively to the surface of the earth; and if we allow ourselves to adopt this view, we may easily imagine that in the equatorial regions there may exist an upper current from the east having sufficient velocity to meet the case supposed. But can this view be justified? Is it not more reasonable to consider that the whole of the earth's atmosphere rotates with the earth as if it were part and parcel of it? It is difficult to see why it should not do so, unless we suppose a resisting medium occupying the inter-planetary spaces.

It is certainly remarkable how well (on the volcanic hypothesis) the entire observations of the coloured sunsets and associated phenomena agree with the supposition of an east wind sweeping round the earth with hurricane speed in the upper regions of the atmosphere. Not only the observations from the Mauritius, Cape Coast Castle, Brazil, and the West Indies, but even those from the Sandwich Islands and from Australia, may be made to harmonise with this theory, and the dust from Krakatoa may be said to have made "a girdle round the earth" in a fortnight. But in case the theory should prove to be inadmissible, it may be worth while to inquire whether some of these earlier observations may not find their explanation in an earlier eruption of the same volcano. The first eruption of Krakatoa is said to have occurred on May 20, and it is evident that long before the date of the great eruption (August 26) enormous quantities of material had been ejected, vast fields of floating pumice having been met with in the neighbouring seas at various times between July 9 and August 12. GEORGE F. BURDER

Clifton, January 7

ONE feature of the recent sunrises I have not seen described, viz. a large and striking pink semicircle opposite the sun, having a bluish centre. I have only twice seen it well marked, viz. on November 27 and December 15. This seems to be one distinct mark of difference between these sunrises and ordinary ones, inasmuch as I never saw it before, though possibly this may be partly owing to the phenomenon only lasting a few minutes at each time. On November 27 it was at its height at 7.43 a.m. At 7.50 there was only a trace of it left. On December 15 it was at its height at 8.6 a.m. At 8.4 it was very faint, and by 8.16 it had again become so, and was whitish. At 8.6 a.m. the north-western sky was darkish to an altitude of about 5°, and light pinkish purple thence to 10°; so far the appearance was quite ordinary; but on the darkish sky rested the broad half ring, which was pink, but the inner part inclining to salmon-coloured. Being much brighter than the pinkish purple, it obscured it where they crossed. I estimated the radius of its outer edge at about 25°, and therefore its apex was about 30° in altitude. Within the ring was a bluish-white semicircle of about half the radius of the pink semicircle; which was thus 12° or 13° in width. The sky beyond was blue. The phenomenon seemed to be an ordinary cirrus, though this was of an indefinite type; the spaces between its wisps were pretty blue in all parts of the north-western sky, but partook somewhat of its colour. On November 27 there did not appear to be any cirrus, but the semicircle must have been on the film which has been so remarkably coloured during sunrise and sunset. I have noticed traces of this semicircle on one or two other mornings, but so faint that I should not have noticed it if I had not looked for it. I presume that it is of the same character as the pink circle with green or blue centre that has been visible round the sun by day. This also is a phenomenon which I never observed previous to last month; it was most striking about the 26th, but continues to be seen almost daily. This

favours the volcanic dust theory; for it is strange that I should never have noticed it before, if it is of common occurrence; still we know that a phenomenon is more easily seen again after it has once been observed, than seen in the first instance. Can these pink rings be accounted for optically? If they could, would it not throw much light upon the cause of the fine sunrises and sunsets?

With regard to the height of the film which has caused these, I should like to ask whether it is considered proved that the sun is actually shining on it so far into the twilight, or whether the glow may not be caused by reflection from bright sky upon which the sun is really shining. The after-glow among the Alps is clearly caused in this latter way, and not by the sun shining upon the mountains themselves. At the same time, the appearance of cirrus clouds dark against the bright sky, as occurred this morning at about 7.40 a.m., seems to point to the film being far above them.

THOS. WM. BACKHOUSE

Sunderland, December 19, 1883

P.S.—This morning the pink half-ring was again conspicuous, only the inner half was nearly white; within was the blue, darkish, as before. It was at its best at 8.10 a.m.

December 20, 1883

T. W. B.

I learned from a Dutch paper (but I forget from which) that a *blue sun* was observed at Paramaribo in the beginning of September (I think it was the 2nd or the 6th).

Stuttgart, January

E. METZGER

The following letter appears in the *Times* of Tuesday:—

"A shower of matter having 'a white sulphurous appearance' is reported from the vicinity of Queenstown, Cape Colony, towards the close of November. The appended paragraph, giving an account of the phenomenon, is extracted from a Kimberley (Griqualand West) newspaper of December 1. Taken in connection with the description in your correspondence columns of December 25 of a somewhat analogous shower at Scutari, the paragraph is certainly interesting, and, perhaps, of value to physicists investigating the cause of the recent celestial phenomena."

"WALTER CLARK

"Edinburgh, January 3

"We were informed yesterday of the occurrence at Glen Grey, about twelve miles from Queenstown, of a phenomenon which, while it lasted, nearly terrified the white and native population out of their wits. On the afternoon of Wednesday a thick shower of matter, presenting a white sulphurous appearance, fell in the valley in which this village is situate, and, passing right over it from east to west, covered the entire surface of the country with marble-sized balls of an ashy paleness, which crumbled into powder at the slightest touch. The shower was confined to one narrow streak, and while it lasted, we are told, the surrounding atmosphere remained unchanged and clear, as it had been before. Great noises accompanied the shower, and so frightened the people working in the fields, who at first were under the impression that it was a descent of fire—the white substance glistening in the sun—that on perceiving it they fled into their houses for shelter. No damage was caused by what fell, and upon examination of the substance afterwards it was found to be perfectly harmless. At first the little balls were soft and pulpy, but they gradually became dry and pulverised, crumbling at the touch. We have before us a piece of earth on which one of them fell, and the mark left behind resembles a splash of lime-wash or similar matter. It does not smell of sulphur."

MR. JOHN TEBBUTT, of Windsor Observatory, N.S.W., writes as follows to the *Sydney Herald*:—"The appearance presented by our evening skies for some weeks past has been the subject of general remark. Last evening, the 14th, the sky was almost cloudless after sunset, and the usual brick-red light again made its appearance along the west-south-west horizon. It was reflected apparently from an almost invisible and gauze-like cloud in the higher regions of the atmosphere. About seven o'clock the red glow was at its maximum, when a solitary cloud, whose apparent surface did not exceed ten square degrees, presented itself above it at an altitude of 25°. This cloud, which was at first white, quickly changed to a beautiful green, its borders being of a deeper tint. Of all the cloud phenomena that I have witnessed, it was one of the most remarkable. It retained its green colour for the space of about ten minutes, being all the time subject to much internal commotion. It soon afterwards

resolved itself into several cloudlets, and finally disappeared. Two or three other small clouds were visible at the same time, and about the same altitude above the northern horizon, but these were of a gray colour throughout. The eastern sky about the moon was of that deep blue which is frequently observed to surround her when rising during the winter oppositions. Shortly after the dispersion of the green cloud, the ruddy glow gave place to the ordinary pale gray of the twilight, but by half-past seven o'clock the western sky became suffused with red, but this time of a clearer and more aurora-like tint. It did not appear, as in the former case, to be reflected from hazy cloud, and it extended much higher in the sky. This repetition of the ruddy glow on the same evening is a phenomenon which I had witnessed on several occasions during the present month. I remember that many years ago (probably twenty-five) a somewhat similar patch of red light used to make its appearance regularly after sunset in the west-north-west. This phenomenon occurred previously to the commencement of my regular meteorological observations in 1863, and was, I think, contemporaneous with a very dry winter. That the present ruddy skies are not merely a local phenomenon is obvious from the fact that they have been regularly observed during the past three months over a considerable portion of the Indian Ocean.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

CAMBRIDGE.—The following appointments have been made in accordance with Grace No. 19, confirmed on December 6 last:—J. H. Randell, B.A., Pembroke College, Assistant Demonstrator in Physics; J. C. McConnell, B.A., Clare College, Assistant Demonstrator in Physics; R. H. Solly, Demonstrator in Mineralogy, and Assistant Curator of the Museum; Walter Gardiner, B.A., Clare College, Demonstrator in Botany; A. Sheridan Lea, M.A., Trinity College, Senior Demonstrator in Physiology; W. D'Arcy Thompson, B.A., Trinity College, Junior Demonstrator in Physiology; A. Harker, B.A., St. John's College, Demonstrator in Geology. Baron Anatole von Hügel has been appointed Curator of the Museum of General and Local Archaeology.

SCIENTIFIC SERIALS

THE *American Journal of Science*, December, 1883.—Some points in botanical nomenclature, a review of "Nouvelles Remarques sur la Nomenclature Botanique," par M. Alph. de Candolle, Geneva, 1883, by Asa Gray. The main object of this very valuable contribution to the vexed subject of botanic nomenclature is to enforce the principles and supplement the data supplied by M. de Candolle in his epoch-making work. His doctrines are on the whole cordially accepted, and often very ably illustrated, while here and there some useful suggestive remarks and criticisms are offered on matters of detail upon which diversity of opinion and practice still prevails.—Precarboniferous strata in the Grand Cañon of the Colorado, Arizona, by Charles D. Walcott. The results are here embodied of over two months' careful examination especially of the Kaibah Division of the Grand Cañon and lateral gorges undertaken during the winter of 1882-3. The author, an active member of the United States Geological Survey, concludes that the Grand Cañon and Chuar groups correspond to that of the Keweenawan of Wisconsin, both being referable to the Lower Cambrian. Jointly with the Paradoxides horizon of Braintree, Massachusetts, and St. John's, New Brunswick, the olenellus of Nevada, Vermont, New York, and Newfoundland, and the Potsdam series of Wisconsin, New York, Canada, &c.; they constitute the Cambrian age as so far determined in North America.—Contributions to meteorology, nineteenth paper, with three plates, by Prof. Elias Loomis. This paper deals at some length with the barometric gradient in great storms. The results confirm in a general way the accuracy of Ferrel's formula:—

$$G = \frac{1076 \cdot 4 (2n \cos \psi + v) s P'}{\cos^2 i (1 + .004t) P'}$$

where G denotes the barometric gradient in millimetres per degree of a great circle, or sixty geographical miles. But it is shown that the effect of friction is considerably greater than was supposed by Ferrel.—A brief study of Vesta, by M. W. Harrington. The author considers it probable that this asteroid has a